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ABSTRACT

This qualitative study investigated six beginning elementary teachers' beliefs about mathematics and mathematics pedagogy and explored the relationships between their mathematics beliefs and teaching practice. A key question that was addressed was "What are the primary factors that influence beliefs, practices, and the consistency between beliefs and practices?" Data were collected primarily through interviews, observations, a concept-mapping activity, and a questionnaire. A model of the mathematics beliefs and practice relationships was developed prior to the investigation and was revised based on results of the study. Findings showed that prior school experiences and teacher education programs were the key influences on beliefs, and mathematics beliefs and students' abilities were the primary influences on teaching practices. Time constraints and lack of resources accounted for the majority of inconsistencies between beliefs and practice. (Author/MKR)

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UNRAVELING THE RELATIONSHIPS BETWEEN BEGINNING ELEMENTARY TEACHERS' MATHEMATICS BELIEFS AND TEACHING PRACTICES

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UNRAVELING THE RELATIONSHIPS BETWEEN BEGINNING ELEMENTARY TEACHERS' MATHEMATICS BELIEFS AND TEACHING PRACTICES

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In this qualitative study I investigated six beginning elementary teachers' beliefs about mathematics and mathematics pedagogy and explored the relationships between their mathematics beliefs and practices[1]. A key question that was addressed is "What are the primary factors that influence beliefs, practices, and the consistency between beliefs and practices?" Data were collected primarily through interviews, observations, a concept-mapping activity, and a questionnaire. In addition, a model of the mathematics beliefs and practice relationships was developed prior to the investigation and was revised based on results of the study. Findings show that prior school experiences and teacher education programs were the key influences on beliefs, and mathematics beliefs and students' abilities were the primary influences on teaching practices. Also, time constraints and lack of resources account for the majority of inconsistencies between beliefs and practice.

MOTIVATION FOR THE STUDY

In this investigation I explored six beginning elementary teachers' beliefs about mathematics and mathematics pedagogy and I observed their mathematics teaching practices in an effort to better understand the relationships between beliefs and practices. Studies have shown (e.g., Thompson, 1984) that there are times when one's mathematics teaching practice is consistent with one's mathematics beliefs, and there are times when it is not. Upon determining the levels of consistency between beliefs and practice, it is also important to address the question, "What are the primary factors that influence teachers' mathematics beliefs, teachers' mathematics teaching practices, and the levels of consistency between mathematics beliefs and practices?"

There is a need to study teachers' mathematics belief systems. Researchers in mathematics education suggest that the beliefs a teacher has about what mathematics is and what it means to know, do and teach mathematics can be driving forces in that teacher's instruction of mathematical ideas (Cooney, 1985; Kloosterman & Stage, 1989; Lester, Garofalo, & Kroll, 1989). Some mathematics educators have conducted studies and have begun theorizing about the role that beliefs play in understanding mathematics education. Clark and Peterson's (1986) review of literature on teachers' thought processes, for example, notes the importance of understanding teachers' implicit theories and beliefs about education. Thompson (1984) and Peterson, Fennema, Carpenter, and Loef (1989) assert that teachers' beliefs can have profound, but possibly subtle, effects on their mathematics teaching. Accordingly, research has also indicated that the study of teacher preparation should include not only an examination of content knowledge, but also of thinking processes, attitudes, and beliefs held by preservice and elementary teachers (Peterson et al., 1989).

The existing interpretive investigations of teachers' mathematics beliefs that have been coupled with observations of actual practice have primarily focused on teachers at the junior high (Jones, 1990; Thompson, 1984) and high school levels

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[1] This paper is based on my dissertation study done at Indiana University under the direction of Dr. Peter Kloosterman.

(Kesler, 1985; Shaw, 1989), and on preservice student teachers (Owens, 1987). One subgroup of teachers that has been virtually overlooked in interpretive mathematics beliefs studies is the elementary teacher, in particular the beginning elementary teacher.

Beginning elementary teachers' mathematics beliefs are important to explore for four reasons: (1) as previously mentioned, elementary teachers have not been the primary focus of many interpretive studies that explore the beliefs of **mathematics** teachers; (2) elementary teachers play a vital role in developing students' initial understanding of and beliefs about mathematics; (3) beginning teachers are just starting to build their teaching practice, thus tracking the development of their style of teaching can reveal a lot about their beliefs; and (4) a beginning teacher's beliefs about mathematics and teaching mathematics are likely to be challenged during the first few years of teaching.

Six beginning elementary teachers participated in this study and provided some answers to the questions of (1) what beliefs do beginning elementary teachers have about mathematics and mathematics pedagogy and what do these teachers identify as the key influences on their beliefs, (2) what are these six beginning elementary teachers mathematics teaching practices like, and what do they name as the primary influences on their practices, and (3) how are these six teachers' mathematics beliefs related to their practices, and how do they account for the inconsistencies between beliefs and practice?

In order to help clarify the questions at hand and to attempt to put the pieces of the beliefs-practice puzzle together, I created a concept map (see Novak & Gowin, 1984, for a discussion of concept maps) to help analyze the relationship between one's mathematics beliefs and teaching practice. This concept map led to the development of an initial model of the relationships between mathematics beliefs and practices (see Raymond, [1993] for a detailed description of the initial model). My model of the relationships between mathematics beliefs and practices helped me to determine the procedures that I followed in this investigation.

METHODOLOGY

The study was conducted via a naturalistic inquiry approach. The participants in the study were six beginning elementary teachers who were all graduates of Indiana University and who had been placed in teaching positions within a 50-mile radius of Bloomington, Indiana. Of the six teachers, five were females and one was a male. The procedures for data collection included seven individual interviews, five classroom observations, an analysis of the participants' lesson planning styles, a take-home beliefs questionnaire, and an activity involving the pieces of my model of the relationships between beliefs and practice.

The analysis of the data took place throughout the data collection phase and beyond, and includes feedback from two study debriefers and comments from the respondents. Each teacher's beliefs about mathematics and mathematics pedagogy

were categorized as *traditional*, *primarily traditional, an even mix of traditional and nontraditional, primarily nontraditional,* or *nontraditional*. Determination of each teacher's beliefs categorization was based on descriptions of traditional and nontraditional perspectives on mathematics and mathematics teaching and learning as described in recent literature (NCTM, 1989, 1991; National Research Council [NRC], 1989).

Similarly, each teacher's practice was categorized on the same "traditional/nontraditional scale " by measuring the extent to which her practice, regarding the classroom environment, types of mathematical tasks, the kinds of discourse, and the means of evaluation, matches the "nontraditional" type of practice described in the *Professional Teaching Standards* (NCTM, 1991). Categorizations of beliefs and practices were compared and discussed in light of the primary influences on beliefs and practices, and the reasons for inconsistencies were identified by the teachers. The final stage of the analysis consisted of the development of a revised model of the relationships between mathematics beliefs and practices based on the findings from the study.

FINDINGS FROM THE STUDY

The findings of the study provide insight into elements that play key roles in the relationships between beginning elementary teachers' mathematics beliefs and practices. They center around the identification of factors that influence elementary teachers' mathematics beliefs, factors that influence elementary teachers' mathematics teaching practice, and factors that cause inconsistencies between beliefs and practices. The findings provide implications for the role that teacher education programs may play in the relationships.

First, the six teachers in the study named past school experiences, prior teachers, their own teaching practice, and their teacher education program as the primary influences on their mathematics beliefs. Several "weaker" influences mentioned were the classroom situation and personal family experiences. These same teachers identified their mathematics beliefs and the abilities of their students as the main sources of influence on their teaching practices. They also indicated that the particular mathematics topic at hand, the school environment, prior teachers, and the mathematics curriculum played a role in determining their practices.

Some results of this study support key findings from other studies (Brown, 1985; Jones, 1990; Thompson, 1984). Specifically, there is a strong relationship between a teacher's mathematics beliefs and teaching practices, and a teacher's mathematics teaching practice is not always consistent with her mathematics beliefs. This investigation also showed that there is a reciprocal influential relationship between beliefs and practice. However, the teachers in this study indicated that their beliefs influenced their practice more than their practices influenced their beliefs. In addition, the teachers displayed a wide range of consistency between beliefs and practice, with two teachers showing a high level of consistency, two showing a

moderate level, and two showing only a modest level of consistency. A number of explanations for the inconsistencies that occurred were offered by the teachers, including time constraints, scarcity of resources, classroom management problems, and state standardized testing requirements.

In addition, the teachers in this study felt that it was more the case that inconsistencies occurred when influences (other than beliefs) on practice conflicted with beliefs, dominating beliefs at a particular moment, resulting in teaching practice that was not in agreement with beliefs. This result supports Brown and Borko's (1992) contention that while beginning teachers are being socialized into the teaching profession, it is often the case that institutional factors, such as time limitations and standardized testing pressures, create conflicts between beliefs held by teachers about the ideal kinds of practice they would like to implement and their actual practice. Conflicting constraints cause teachers to make teaching choices that do not necessarily match their current pedagogical beliefs.

The model of the relationships between mathematics beliefs and practice that resulted from findings in the study is shown in Figure 1. The model represents my vision of the relationships that was influenced by my conversations with, and observations of, the teachers.

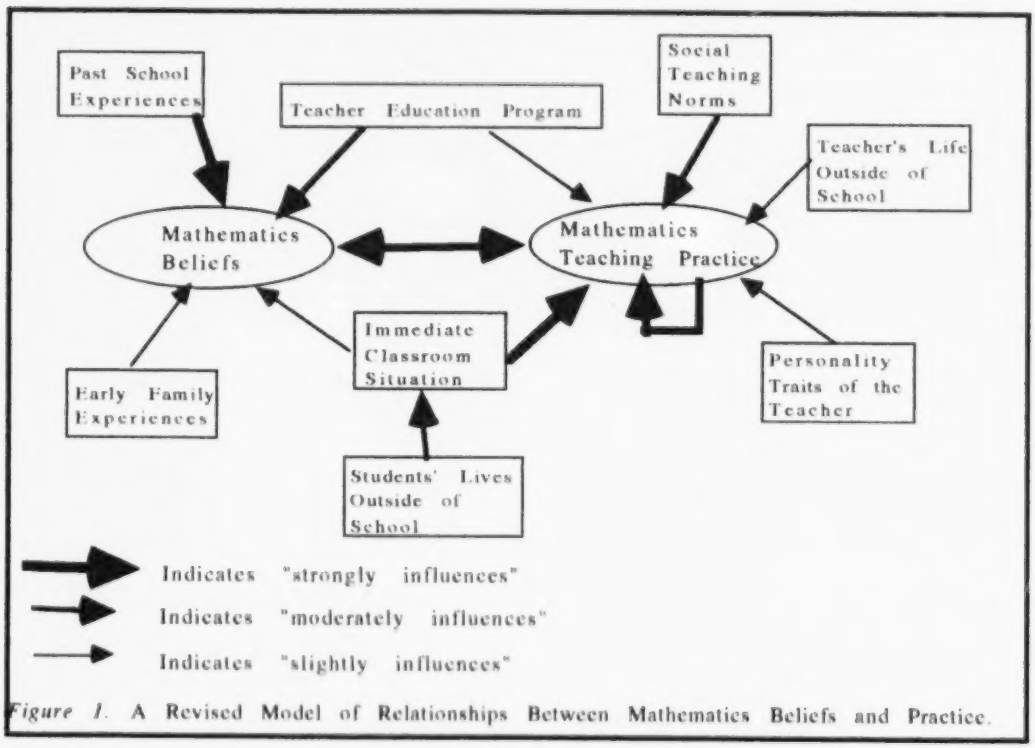

Figure 1. A Revised Model of Relationships Between Mathematics Beliefs and Practice.

As the above model indicates, the results of the investigation showed that these beginning elementary teachers did not attribute much weight to their teacher education programs in terms of their influence on their mathematics teaching

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practice. However, they thought that their teacher education experience had a moderate level of influence on their beliefs. The teachers involved in the study thought that teacher education programs could do a better job of addressing the issue of the relationship between beliefs and practice, perhaps by offering a forum for helping preservice teachers develop their own philosophy of mathematics education before stepping into the classroom. These teachers believed that a stronger sense of self awareness about their mathematics beliefs, in conjunction with a deepening of their mathematics content and pedagogical knowledge, would help to make their teaching practice stronger, more focused, and, perhaps, more consistent with their mathematics beliefs.

IMPLICATIONS FOR MATHEMATICS TEACHER EDUCATION

The findings of this study hold a variety of implications for teacher education. The first and foremost implication is that mathematics beliefs need to be explicitly addressed in teacher education programs. Specifically, preservice teachers should be challenged to discover their own beliefs about mathematics, perhaps by writing their own mathematics diary. They ought to be asked to recount their own school experiences with mathematics as students and to assess their abilities to do mathematics and their confidence in teaching mathematics.

Along with exploring their personal relationships with mathematics, preservice teachers should be asked to describe for themselves what they believe mathematics is all about, and they should debate the issues of what they consider are the best ways to learn and teach mathematics. This should be done within a context of exploring various mathematics learning and teaching styles, allowing students to make their own connections between what methods of teaching mathematics are available and what styles they believe best match their own philosophies of mathematics pedagogy.

I believe that we need to be as realistic as possible with future teachers when preparing them for their profession. Why not talk with them about the socialization process that they will face, and share with them the types of conflicts and choices they are inevitably going to see during their beginning years of teaching? If they are made aware of the fact that their ideal beliefs about teaching may not conform to the realities of teaching, perhaps they will be better able to cope with the conflict if and when it arises. After all, it should be our goal to not only help preservice teachers develop an awareness of their beliefs about mathematics teaching, but to prepare them for the inevitable challenges to their beliefs. This will allow them to confront challenges without upsetting the balance between beliefs and actual practice. Institutional constraints are not likely to disappear in the near future, so sharing ways of coping with them without abandoning ideals should be pursued in teacher education.

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